State of New Jersey
Department of Environmental Protection

Christine Todd Whitman
Governor

Robert C. Shinn, Jr.
Commissioner

April 21, 1999

Mr. William Guarini
Vice President, Government Programs
Envirogen
Princeton Research Center
4100 Quakerbridge Road
Lawrenceville, New Jersey 08648

Re: Envirogen Fluidized Bed Reactor Innovative Environmental Technology Certification 99001

Dear Mr. Guarini:

Enclosed is the New Jersey Department of Environmental Protection's (NJDEP) Innovative Environmental Technology Certification based on the validation of your technology through New Jersey's Environmental Technology Certification Program. The NJDEP Certification validated the performance claims of the Envirogen Fluidized Bed Reactor to treat groundwater contaminated with aniline and nitrobenzene. The FBR has been verified through valid quality control sampling and analytical methods. The evaluation documented a net beneficial effect of the FRB to treat contaminated groundwater in an efficient and effective manner. The evaluation was documented through a pilot plant facility and confirmed with operational data from a full-scale facility.

Envirogen's technology verification was part of a pilot program that assisted NJDEP in the establishment of our Innovative Environmental Certification program. This includes the performance partnership with the New Jersey Corporation for Advanced Technology (NJCAT) to perform third party independent verification. The process developed through the NJDEP pilot program is for technologies to be verified through NJCAT. Those verifications found acceptable are certified within our program, and linked to a regulatory acceptance. That acceptance will provide for appropriate regulatory flexibility to help commercialize a technology that results in a cleaner environment. This connects technology acceptance with regulatory acceptance. Your pilot program evaluation has assisted NJCAT and NJDEP in the development of our evaluation protocols. I want to congratulate you on assisting us through this process.

Increasing the use of innovative environmental technologies that have a net beneficial effect and that can assist the Department in improving our state's overall environmental quality face a two prong barrier to their commercialization and deployment. One is that investors and users of the environmental technology may not have access to third party validated data of the performance and the potential successes of the technology. The other is that investors and vendors of the environmental technology face a fragmented market place represented by 50 individual state approval programs. The New Jersey verification and certification process can, in part, address these barriers.

The verification of the environmental performance of an innovative environmental technology by a third party entity such as NJCAT is of itself a valuable commodity. It can provide a high degree of confidence to a private sector developer who is seeking to invest in or install and use new environmental technology that can go beyond compliance with regulatory permits or standards. The key to completing our response to barriers to deployment of new environmental technologies is to link the technology verification to a regulatory determination. Linking this to the NJDEP certification adds to the reduction of the barriers to the deployment of new environmental technologies by increasing access to valid third party evaluation data. This could assist in increasing investment in and use of innovative environmental technologies that can improve New Jersey's environmental quality indicators as established in the NJDEP Strategic Plan.

In order to multiple this effect, the technology and regulatory connection needs to be further linked to an interstate reciprocity process, which has been developed through the Six-state MOU. This means that the environmental and operational data and the overall performance of the Envirogen process as certified by NJDEP is accessible and useable to other states as outlined in the Six-state MOU Pilot Project Strategies Report. This will interconnect environmental technology and regulatory acceptance in a way that we, State environmental agencies, can now respond to the real or perceived barriers to environmental technology deployment.

Again, congratulations on your success. The Department through the Commerce Commission and the Department of Treasury will continue to work closely with Envirogen to provide appropriate assistance through a broad array of market applications. A market assistance program that is immediately available is through the Brownfield and Contaminated Sites Remediation Act NJSA 58:10B-6a. This Act can provide matching funding through the Hazardous Discharge Site Remediation Fund for up to 50% or $200,000 of the project cost to perform the remedial action certified by NJDEP.

Sincerely,

Robert C. Shinn
Commissioner

Enclosure

C Rick Gimello, Assistant Commissioner Site Remediation
Gary Sondermeyer, Assistant Commissioner Environmental Regulation
Robert Tudor, Assistant Commissioner Environmental Planning and Science

The New Jersey Department of Environmental Protection
Innovative Environmental Technology Certification
of

Environgen Fluidized Bed Reactor System
for the
Treatment of Aniline and Nitrobenzene in Groundwater

The New Jersey Department of Environmental Protection (NJDEP) specifically the following programs:

1. Office of Innovative Technology and Market Development (OITMD), Division of Science, Research and Technology (DSRT);

2. Bureau of Environmental Evaluation, Clean-up and Response Assessment
   Division of Responsible Party Site Remediation;

3. Bureau of New Source Review
   Division of Air Quality

assisted in the development of the structure of the performance claims with Envirogen to facilitate consistency with NJDEP's regulatory determinations. The Department has evaluated Envirogen's report to determine its overall conformance with the verification/certification procedure developed by OITMD. This evaluation served as a technical review for finalizing the NJDEP certification pathway for Innovative Environmental Technologies (IETs). The Department finds the following conditions exist:

1. The sampling and analytical plans for the Envirogen Fluidized Bed Reactor (FBR) System evaluated by NJDEP were developed in accordance with acceptable methods and procedures. Data were collected to document the performance of the FBR in accordance with acceptable protocol. The samples were analyzed by state certified laboratories independent of Envirogen. The data was evaluated in accordance with established quality assurance project plan (QAPP) method.

2. The verification data were collected from a pilot plant installed at the site under a defined testing protocol. Influent data from the groundwater feed to the FBR as follows:

Contaminant	Arithmetic Mean Mg/1	Median Mg/I	90th Percetile' mg/I	Maximum mg/I
Aniline	10.98	5.87	18.98	93
Nitrobenzene	70.45	53.26	143.52	148

'90 percent are less than stated value.

The performance claims were that the FBR could achieve the required treatment for reinjection of the treated groundwater. These standards are 5 mg/I for total organics and 0.5 mg/l for any individual compound. The testing indicated acceptable performance of the FBR, within limits. As the system was stressed further, information was also gained on the importance of maintaining equilibrium conditions within the unit.

3. The NJDEP verification/certification serves as a full third party audit of the performance of the Envirogen FBR process.

4. The NJDEP verification/certification confirms that the technology can perform within acceptable limits for the following:

    a. Aniline concentrations less than 93 mg/l.

    b. Nitrobenzene concentrations less than 148 mg/I

5. Based on the NJDEP verification/certification, the overall net beneficial effect of the FBR process is positive. The FBR process can treat contaminated groundwater and return the site to a clean environment. The contaminants are biologically degraded within the FBR and rendered unavailable to the environment.

6. This technology can assist in the advancement of the following milestones and strategic actions as set forth in the Department's Strategic Plan:

    C. Safe and Health Community

    The remediation of hazardous discharge sites will be accelerated. The Envirogen FBR process provides a treatment technology for contaminants, which have in the past been difficult to apply bioremediation. Exposure to environmental risks will be controlled and minimized.

    D. Health Ecosystems

    Pursue partnership or other agreements with outside parties to promote protection and preservation of ecosystems. The Envirogen FBR certification will be distributed for technical acceptance with the Six-state MOU and the Interstate Technology and Regulatory Cooperation Work Group States.

    E. Open and Effective Government

    Develop and implement an integrated information infrastructure that will provide all internal and external constituents with easy and effective access to information and that fosters the best administrative and environmental decision making. The Envirogen FBR Certification will be made available through the NJDEPOITMD web site and will be incorporated into the database being developed within the Six-state MOU.

    Encourage industry to voluntarily reduce risk and implement pollution prevention efforts.

    Develop and implement holistic approaches to facility environmental management.

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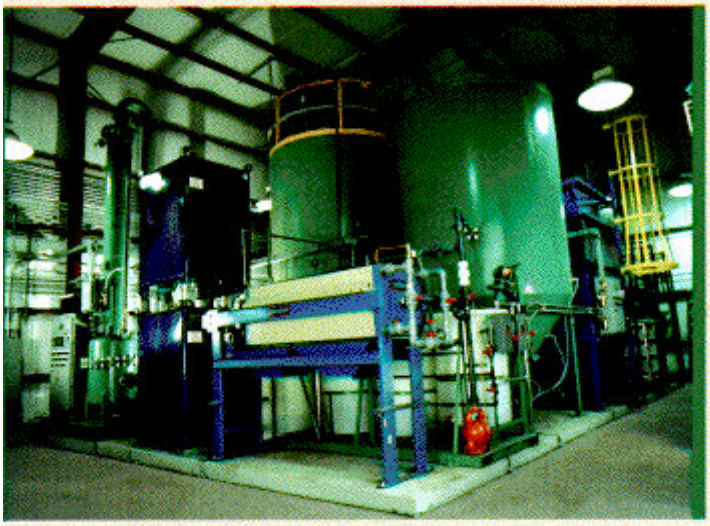
Robert C. Shinn, Jr. Commissioner Date



Fluidized Bed Reactor treating aniline and nitrobenzene contaminated wastewater in New Jersey.

Envirogen's expertise in developing and delivering microbiological solutions has resulted in high-performance bioreactor systems engineered to meet specific stream contaminants head-on and eliminate them, producing high-quality, potentially recyclable water.

Whether the problem is treating in-plant wastewater streams or pump-and-treat groundwater remediation, there is an Envirogen bioreactor system designed to meet your special requirements.

Envirogen will provide a cost effective bioreactor system best suited to the problems based on flow rates, mix and concentration of organic contaminants, required effluent quality, and the space available for the system.

For a broad range of influent flow rates and contaminant concentration levels, Envirogen's fluid bed reactor (FBR) system is typically most economical.

FLUIDIZED BED BIOREACTOR

Wastewater Treatment System

The FBR is a fixed-film reactor column that fosters the growth of microorganisms on a hydraulically fluidized bed of media, usually sand or activated carbon. The fluidized media provides an extremely large area on which the film of microorganisms can grow thus producing a large inventory of biomass. This high concentration of biomass - usually 5 to 10 times greater than in conventional activated sludge bioreactors - provides the system's high volumetric efficiency.

The contaminated wastewater stream is passed upward through the bed at a sufficient velocity to fluidize – expand – the bed so that the biologically coated particles are suspended in the column allowing the wastewater to come in contact with a large inventory of biomass. The velocity is determined by the specific density and particle size of the media and the required bed expansion.

BENEFITS:

- Cost effective - low capital and O&M costs
- Minimal generation of biosludge
- Variety of contaminants treated
- High quality effluent produced
- Small footprint
- Minimal operator attention required
- Capable of handling both hydraulic and organic shock loads

contaminated incoming waste stream is mixed with ients, oxygen, and pH control chemicals as it is fed the lower portion of the bioreactor. As the microor- isms grow on the media particles of the fluidized , their diameter increases and their density is uced resulting in bed expansion. During the cess, the thickness of the biofilm is controlled to mize the density of the bioparticles and minimize r overflow with the effluent. The long solids retention characteristic of the system allows for the removal complex organic compounds while minimizing cess upsets.

When activated carbon is used, the FBR system combines biotreatment with activated carbon's physical and chemical adsorptive mechanism in a single reactor system to remove complex contaminants from waste streams. The particular media used is precisely tailored to the contaminants present. The result is clean effluent coming off the top of the reactor. Figure 1 below shows the simplicity of the system that can operate in either a once-through or a recycle mode.

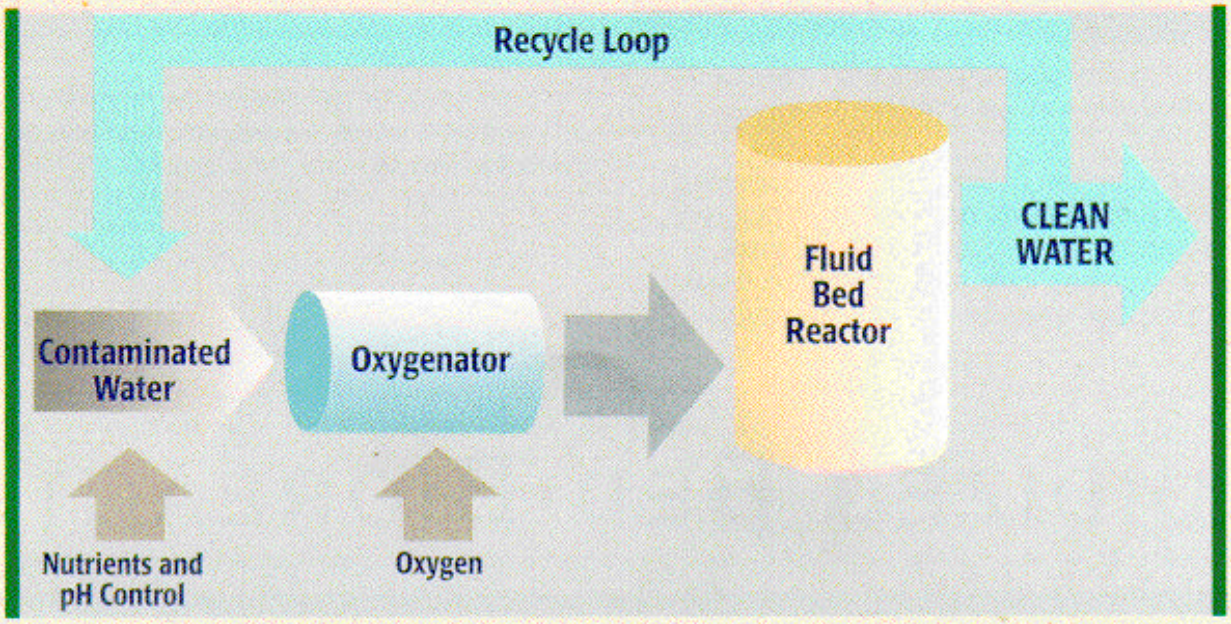


Figure 1: Fluidized Bed Reactor system simplified process flow diagram

atever the problem stream – aromatics, solvents, rinated solvents, hydrocarbons, BTEX, ammonia, itrates – the FBR system handles high flows of se and other contaminants.

The FBR's typical treatment efficiency is:

- 97+% for nitrobenzene
- 97+% for aniline
- 95+% for methylene chloride
- 98+% for toluene
- 99+% for BTEX.

For more information about Envirogen's Water Treatment Systems, please call: (609) 936-9300
In the Gulf Coast area, please call: (281) 493-3772

ENVIROGEN INC.

CORPORATE HEADQUARTERS

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